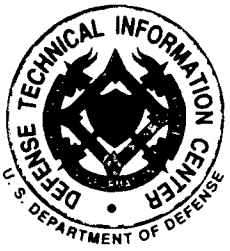

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EQUIPMENT FOR CARRYING OUT TECHNICAL MONITORING Of GAS PUMPING UNITS BY LUBRICATION OIL ANALYSIS

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Abstract: A portable on-line monitor is described which measures iron, copper, tin and aluminium. The device is recommended for use in combustion engines, compressors, turbines, gear boxes, oil and gas pumping systems. The device consists of a set sensors installed into the lubrication system. The sensors measure quantities of wear debris from 0,01 to 200 mg with an estimated error of 2%. As case study of the application of these sensors to a compressor pumping stating is quoted.

Key Words: Electron Devices; Friction Units; Line Debris Monitor; Lubrication System; Sensors.

Among the most important problems high-lighted by the development of the gas industry is that of ensuring that gas pumping units (GPUs) work reliably. This problem is being tackled from many angles. One approach is to improve monitoring methods and equipment.

The introduction of equipment capable of making a swift and precise evaluation of the condition of working GPUs enables correct decisions to be taken on the replacement or repair of any defective component parts, or of the unit as a whole, and also allows one to establish the optimum frequency and extent of preventative maintenance.

The on-line monitoring method of analyzing abrasion products in GPU lubrication systems while the unit is operating is an effective method for evaluating, controlling and predicting the condition of GPUs.

The most widely used method is spectral anaylsis of oil samples, which is characterised by rapidity, precision and sensitivity [1, 2]. However, taking periodic oil samples from GPU lubrication systems, sending them to diagnostic centres for analysis, and receiving back findings on the condition ofthe unit involves considerable expenditure of time. The most promising method of getting quick information on the condition of the GPU at the combustion chamber while it is actually working is by using primary monitoring equipment. The apparatus recommended in studies 3 and 4 for evaluating the condition of GPUs is the FS (FS-112; FS-

151) analyzer (meter) for carrying out dispersion analysis of oil samples from GPU lubrication systems.

Essentially this method involves periodic analysis of the dispersion structure of oil from GPUs directly at the combustion chamber and subsequent comparison of the readings with the maximum permitted values for particle concentration with a view to evaluating the condition of the unit. If the oil samples exceed the maximum permitted values this indicates that the GPU's friction assemblies are not functioning correctly.

As an example, figs 1 and 2 show the dependence of particle concentration of oil samples under dispersion analysis and the indicator elements under spectral analysis on the running time of centrifugal (STD-4000) and piston (10 GKNA) GPUs. Comparing these findings one can note the correlation between the dispersion and spectral analyses which confirmed the presence of three characteristic periods in the units' operation: the running in period, the period where deterioration sets in, and the period of intensive deterioration. The method developed was introduced into the Uzbektransgaz combustion chambers with a saving of R.129,000.

Recently, with combustion chambers going over to systems of non-duty maintenance, studies aimed at developing new methods of tribological monitoring of GPUs using built-in control equipment have acquired special importance. At the industry's laboratory attached to the I. M. Gubkin GANG Centre for Joint Analytical Research one such method has been developed which consists in the sedimentation of abrasion products (APs) on a special apparatus (sensor) where their mass is recorded by an electronic device. [5] The abrasion sensors are mounted in the oil feed line, in the crankcase or directly under the unit's friction assembly, and are connected to the recording device by a screened electric cable. This allows the quantity of both ferro-magnetic abrasion particles and of non-ferrous metal particles present in the sensors' working space to be established. With the help of such built-in control equipment it is possible to differentiate and determine the deterioration rate of the crank and connecting rod assembly, ie each bearing unit (babbit bush) individually, the reduction gear (cogged gearing), piston cylinder group etc.

The I. M. Gubkin GANG and the Gazpriboravtomatika Design Office have developed two design variants of built-in equipment for the tribological monitoring of GPUs: the first type is a small portable device with independent power supply and a set of abrasion sensors for work in the field; the second type is a fixed computerized system, mounted on the combustion chamber control panel, working round the clock, equipped with emergency alarms and carrying out constant monitoring of the sensors. (fig. 3)

The method developed was approved for use on Mostransgaz's Kasimov combustion chambers for Solar type GPU and for piston compressors (PC) type DR-12. Bearing in mind that the Solar plant contain 10 units, a special ten-channel computerized system designed for working with ten abrasion sensors was developed and manufactured.

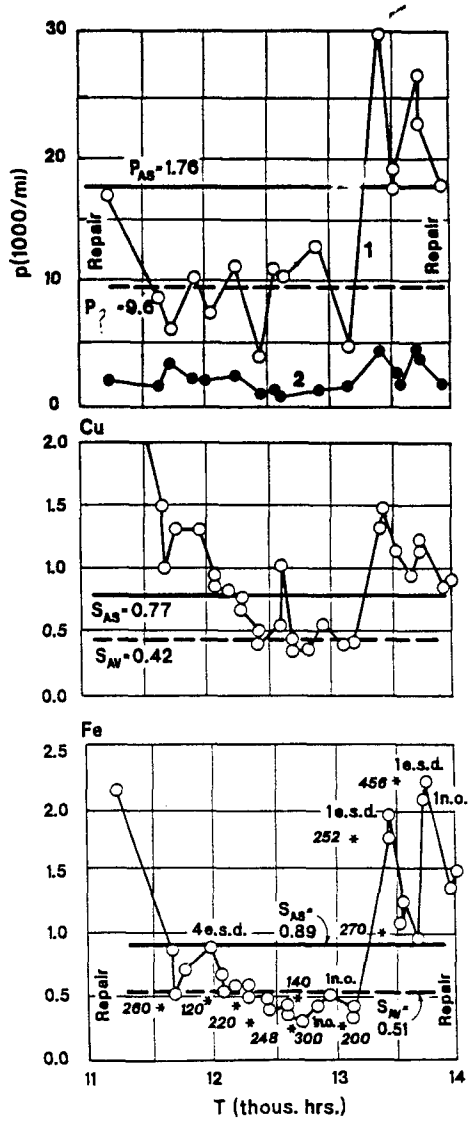

Fig. 1. Dependence of Particle Concentration *p* and Indicator Elements *S* in the Lubrication System of Uzbektransgaz's EGPU CTD-4000 No. 2 Combustion Chamber - 4a on Running Time *T*:

1 and *2* = particle size 5-10 and 10-25mkmk respectively;
*260 = oil added to the GPU, litres;
1 e.s.d. = one electricity shut down; AB]
1 n.o. = one normal stop.

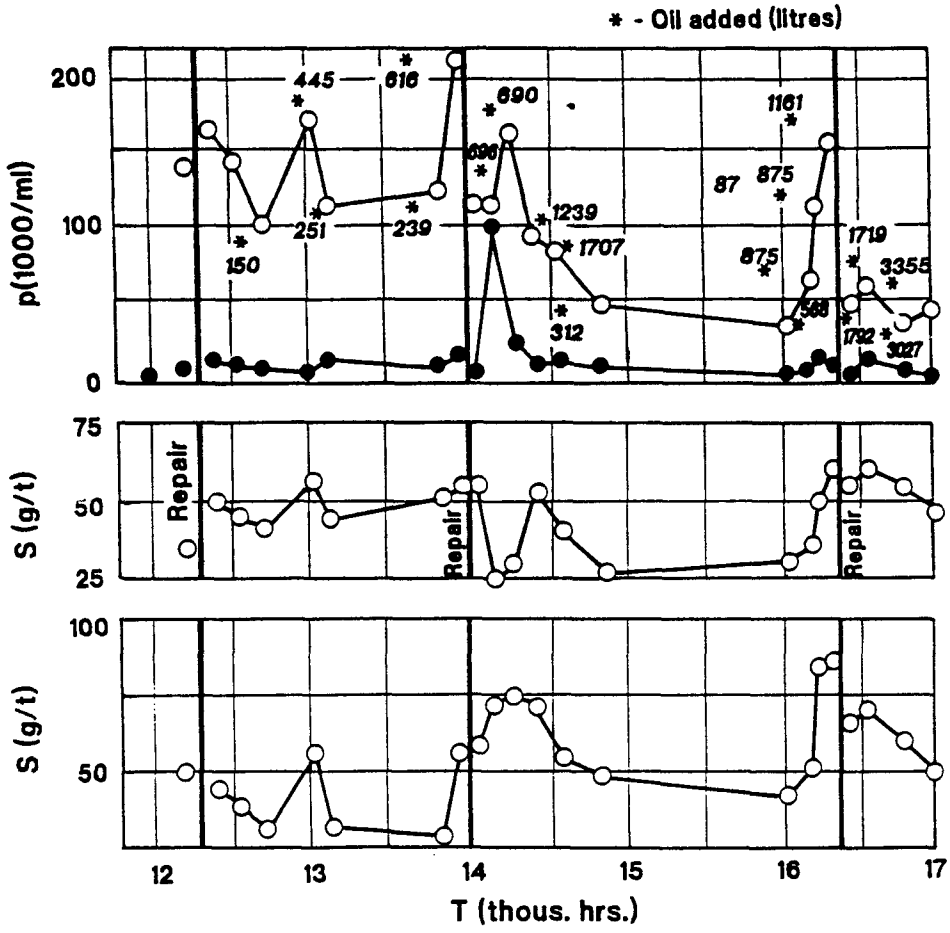

Fig. 2. Dependence of Particle Concentration p and Indicator Elements S in the Lubrication System of Uzbektransgaz's GML 10 GKNA Combustion Chamber-5 on Running Time T.

The sensors were mounted on a common discharge manifold in front of the oil tank on each Solar GPU and on the crankcase discharge on each DR-12 PC (the plant has five units). The computerized recording assemblies were mounted in the control room of each plant. At this particular stage the task was to evaluate the efficiency of the developed and manufactured computerized systems and to compare their findings with the actual condition of each plant. As an example, fig. 3 shows some practical results for DR-12 PC. As can be seen from the graph the friction assembly abrasion varies for each PC. The highest deterioration rate is that for MOGs nos 1 and 3. This example clearly shows the dynamics of defect development. The findings obtained showed that the method developed and the built-in control equipment were efficient and that there was a good correlation with the actual condition of the MOG, which means that they can be recommended for future introduction on other types of GPU.

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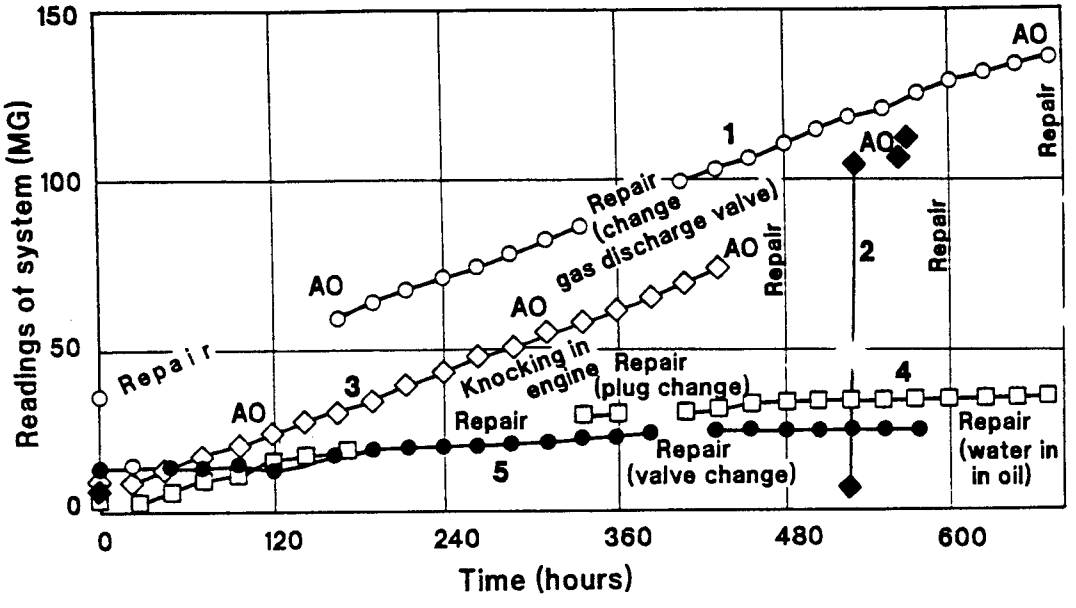

Fig. 3. Dependence of Computerized System Readings on Working Time of Mostransgaz's Kasimov PC Combustion Chamber DR-12.

1, 2, 3, 4, 5 = GMKs Nos 1, 2, 3, 4, 5 respectively.[4]
A0 - damage stop